EXISTENCE OF A TWO DIMENSIONAL POTENTIAL FLOW WITH WAKE PAST A SYMMETRIC CONVEX PROFILE

BY

FRANCIS McCONNELL PULLIAM

A.B., University of Illinois, 1937

A.M., University of Illinois, 1938

AN ABSTRACT OF A THESIS

SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF DOCTOR OF PHILOSOPHY IN MATHEMATICS IN THE GRADUATE SCHOOL OF THE UNIVERSITY OF ILLINOIS, 1947

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A. Weinstein* obtained in 1929 the existence of a jet flow from a smooth nozzle by approximating the given nozzle by polygonal nozzles and letting the number of sides become infinite. The present paper utilizes the same general method in proving the existence of a flow with wake. Novel features of this paper are perhaps the following: departure from the Brillouin restriction to flows in which the speed is nowhere greater than that at infinity; use of unbounded velocities which however disappear in the final limiting process; and use of the restriction $\omega'(o)=o$ introduced by P. W. Ketchum which is found to render existent a certain kinetic energy integral used in the existence proof.

The principal result is the Theorem: There exists a two dimensional potential flow with wake with $\omega'(o)=o$ past any strictly convex profile symmetric with respect to the flow at infinity and with continuously changing slope.

The method of proof is as follows: we approximate the given profile by a polygonal profile of n + 1 sides on each side of the axis of symmetry, the angle between adjacent sides being taken to be α_n/n where α_n is the angle between the inner normal to the profile at the upper point of separation and the

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*A. Weinstein, Zur Theorie der Flussig keitstrahlen, Math. Zeit., v. 31, p. 424.

direction of flow at infinity; using Villat's method of determining $\omega(\tau)$ we show that a flow of the required type exists for such an approximation for suitable α_n; finally we show that as n becomes infinite we get a flow of the required type past the given profile.

VITA

Francis McConnell Pulliam was born in Indianapolis, Indiana, on May 29, 1913. He attended public schools in Illinois and graduated from Kewanee High School at the head of his class. He entered DePauw University as a Rector scholar in 1932 and in the middle of his sophomore year transferred to the University of Illinois. He was elected to Pi Mu Epsilon and Phi Beta Kappa. In 1937 he received from the University of Illinois the degree of Bachelor of Arts with High Tutorial Honors in Mathematics. From the same institution in 1938 he received the degree of Master of Arts. From September, 1937 to January, 1941 he was a graduate assistant in mathematics at the University of Illinois following which until May, 1942 he served as professor of mathematics and physics at Lambuth College. In May, 1942 he entered the United States Marine Corps, saw active duty in the Gilbert and Okinawa campaigns, and was released to inactive duty in February, 1946 with the rank of Captain. He returned to the University of Illinois in March, 1946 as a graduate assistant in mathematics. In 1947 he was elected to Sigma Xi. He was appointed assistant professor of mathematics at the University of Kentucky for the year 1947-1948.